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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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9325109.8 8 December 1993 (08.12.93) GB(71) Applicant (for all designated States except US): SLS (WALES)
LIMITED [GB/GB]; Units 1 & 2, Heol Rhosyn, Dafen
Industrial Estate, Llanelli, Dyfed SA14 8LX (GB).

(72) Inventors; and

(75) Inventors/Applicants (for US only): CLEMENT, Richard,
Marc [GB/GB]; 11 Plas Road, Rhos, Pontardawe, West
Glamorgan SA8 3HD (GB). KIERNAN, Michael [GB/GB];
89 Heol Eddwch, Seven Sisters, West Glamorgan SA10
9AW (GB).(74) Agent: AUSTIN, Hedley, William; Urquhart-Dykes & Lord,
Alexandra House, Alexandra Road, Swansea, West Glam-
organ SA1 5ED (GB).(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH,
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NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, US,
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claims and to be republished in the event of the receipt of
amendments.*

(54) Title: DEPILATION

(57) Abstract

Mammalian hair is depilated using a laser source capable of emitting pulsed radiation, each pulse having a duration of $1\mu\text{s}$ to 1ms , the radiation having a wavelength in the range of 600 to 1500nm . A selected area of a patient's skin is irradiated by the pulsed radiation, the area having a plurality of irradiation zones; the laser source is successively pulsed so as to irradiate successive zones of the treatment area with the radiation, so as to destroy subdermal biological material associated with hair growth.

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Depilation

The present invention is concerned with a method of depilation of mammalian hair and also apparatus for use in the method.

U.S. Patents 3538919 and 4617926 are both concerned with depilation. These patents teach the stepwise irradiation of single hairs or hair follicles; the process described in U.S. 3538919 involves inserting a laser probe within a hair follicle and the process described in U.S. 4617926 involves inserting a single hair within a bore of a fibre optic probe. These processes are time consuming, and can lead to unnecessary discomfort to a patient.

We have now developed a method and apparatus which alleviates the above problems.

According to the present invention there is provided a method of depilation of mammalian hair, which method comprises:

- (a) providing a laser source capable of emitting pulsed radiation, each pulse having a duration of $1\mu\text{s}$ to 1ms , said radiation having a wavelength in the range of 600 to 1500nm;
- (b) selecting a treatment area of a patient's skin to be irradiated by said pulsed radiation, said treatment area including a plurality of irradiation zones; and
- (c) successively pulsing said laser source so as to irradiate successive zones of said treatment area with said radiation, so as to destroy subdermal biological material associated with hair growth.

It is preferred that the laser source comprises either a ruby laser (wavelength 694.3nm), a neodymium YAG laser (wavelength $1.064\mu\text{m}$) or other lasers having a wavelength in the abovementioned (visible red to near infra-red) range. The selection of a laser having a wavelength in the range of 600 to 1500nm is advantageous in that radiation of this wavelength is capable of selectively destroying cells or other subdermal biological material responsible for hair growth, whilst not being substantially absorbed by surrounding cells or tissue.

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It is preferred that a laser with variable pulse duration is used. This is advantageous in facilitating irradiation of selected intensity, depending on the required application of the laser.

Advantageously, the irradiation zones are juxtaposed so as to substantially cover the treatment area. Preferably the successive irradiation involves irradiation in boustrophedon manner, so as to ensure substantially complete irradiation of the treatment area.

It is preferred that the irradiation destroys cells present at the root of individual hair follicles; optionally, the irradiation may further destroy cells present in respective bulge regions of follicles.

There is further provided by the present invention depilation apparatus for use in a method as described above, the apparatus comprising:

- (a) a laser source capable of emitting pulsed radiation, wherein each pulse has a duration of $1\mu\text{s}$ to 1ms , the radiation having a wavelength in the range of 600-1500nm; and
- (b) means for irradiating a zone of a patient's skin with said radiation, so as to be capable of destroying biological material present in said irradiation zone, associated with hair growth.

The apparatus may advantageously further comprise means for effecting irradiation of successive zones of the patient's skin. Typically, means are provided for effecting movement of the apparatus relative to the patient's skin so as to irradiate the skin in a boustrophedon manner substantially as described above.

Claims:

1. A method of depilation of mammalian hair, which method comprises:
 - (a) providing a laser source capable of emitting pulsed radiation, each pulse having a duration of $1\mu\text{s}$ to 1ms , said radiation having a wavelength in the range of 600 to 1500nm;
 - (b) selecting a treatment area of a patient's skin to be irradiated by said pulsed radiation, said treatment area including a plurality of irradiation zones; and
 - (c) successively pulsing said laser source so as to irradiate successive zones of said treatment area with said radiation, so as to destroy subdermal biological material associated with hair growth.
2. A method according to claim 1, wherein said laser source comprises a ruby laser having a wavelength of 694.3nm or a neodymium YAG laser having a wavelength of $1.064\mu\text{m}$.
3. A method according to claim 1 or 2, wherein said laser source has a variable pulse duration.
4. A method according to any of claims 1 to 3, wherein said irradiation zones are juxtaposed so as to substantially cover said treatment area.
5. A method according to any of claims 1 to 4, wherein said successive irradiation of said treatment area is in boustrophedon manner, so as to ensure substantially complete irradiation of said treatment area.
6. Depilation apparatus for use in a method according to any of claims 1 to 5, said apparatus comprising:
 - (a) a laser source capable of emitting pulsed radiation, wherein each pulse has a duration of $1\mu\text{s}$ to 1ms , the radiation having a wavelength in the range of 600-1500nm; and
 - (b) means for irradiating a zone of a patient's skin with said radiation, so as to be capable of destroying biological material present in said irradiation zone, associated with hair growth.

7. Apparatus according to claim 6, which further comprises means for effecting irradiation of successive zones of a patient's skin.
8. Apparatus according to claim 6 or 7, which includes means for effecting movement of said apparatus relative to said patient's skin so as to irradiate said skin in a boustrophedon manner.

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A61B17/41

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|---|-----------------------|
| X | WO,A,92 19165 (VICTORIA UNIVERSITY OF MANCHESTER) 12 November 1992 see page 2, paragraph 3 | 6,7 |
| A | US,A,5 059 192 (ZAIAS) 22 October 1991 see column 3, line 39 - line 40 | 6 |
| A | US,A,4 718 416 (NANAUMI) 12 January 1988 see column 3, paragraph 1 | 8 |
| A | US,A,5 065 515 (IDEROSA) 19 November 1991 see column 2, line 42 - line 45 see column 4, line 34 - line 39 | 8 |

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

28 March 1995

Date of mailing of the international search report

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Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax (+31-70) 340-3016

Authorized officer

Barton, S

INTERNATIONAL SEARCH REPORT

International application No.

CT/GB94/ 02682

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.: 1-5
because they relate to subject matter not required to be searched by this Authority, namely:
PCT Rule 39.1(iv)
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 94/02682

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---------------------|----------------------------|---------------------|
| WO-A-9219165 | 12-11-92 | AU-A- 1981992 | 21-12-92 |
| US-A-5059192 | 22-10-91 | NONE | |
| US-A-4718416 | 12-01-88 | JP-A- 60148567 | 05-08-85 |
| US-A-5065515 | 19-11-91 | NONE | |